NPS Collaborative Technology Testbed for ONR CKM Program

Collaboration and Knowledge Management Workshop
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Research Team

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Students:	IS 4188 Collaborative Technology and Coordination Class, Summer 2004 (18 students)
	Summer 2004 graduates, thesis students: LCDR Eric Bach and LT Ryan Blazevich

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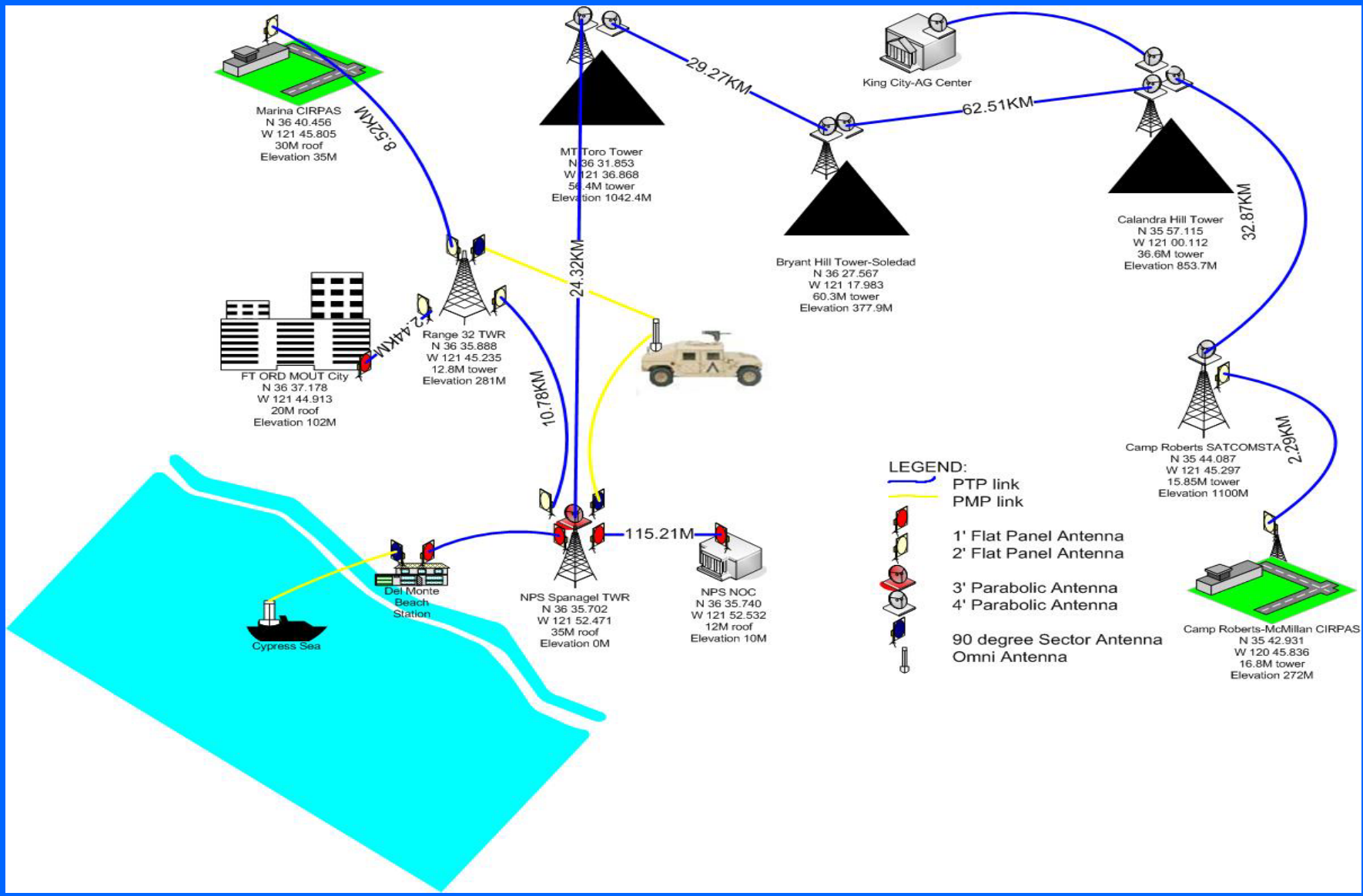
- Dr Mike Letsky-Direction and support
- Dr. Norm Warner-Testbed and NEO Scenario
- Dr. Mike Cowen-NEO Scenario and Experiment Evaluation
- Dr. Pat Winston -EWall Integration
- Dr. Paul Keel-EWall Integration
- Mr. Matthew Sither-EWall Integration
- Ms. Beth Wroblewski-Work with NPS CT Class
- Dr. Jim Just-Agent Technology
- Mr. Aaron Glahe-CoABS
- Dr. Alex Kilpatrick-Groove and CoABS

NPS Testbed Configuration: Tactical Sensor-UV-DM Grid

The NPS STAN-TNT Tactical Wireless Network provided the backbone for the CKM testbed, which was extended to support mesh of tactical collaborating elements

NPS Tactical Wireless Collaborative Technology Testbed Topology



Enablers of Collaborative Technology at Sensor-UV-DM nodes

- Groove peer-to-peer, mesh capable clients
- NPS Situational Awareness Agents (agent services via the CoABS model)
- MIT EWall
- GITI Verona
- Network Management SNMP Agents (enable network awareness to sensor-UV - DM collaborating nodes)

First Testbed Application: NEO Experiment

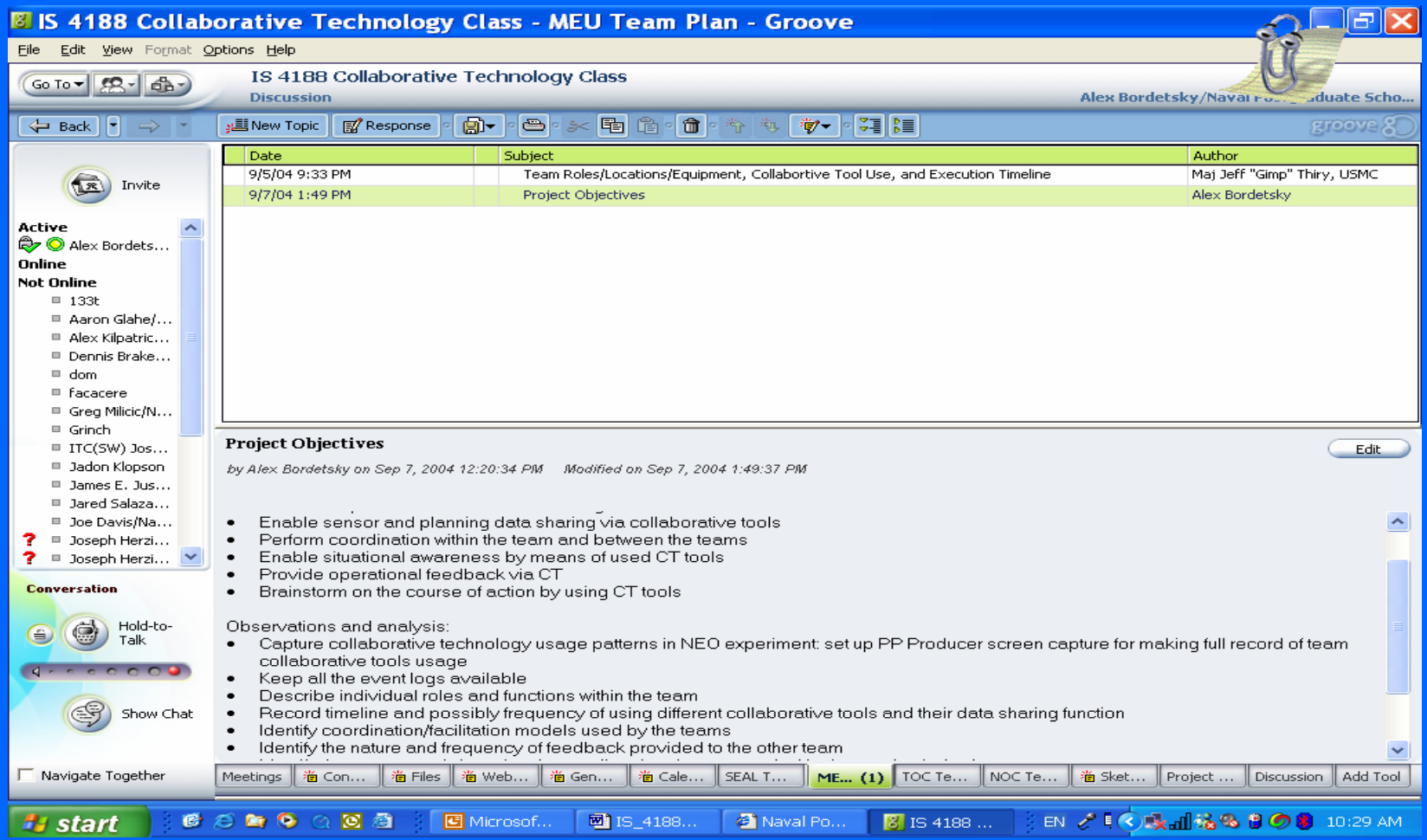
- Identify CT usage pattern during NEO planning and execution phases using the CT package: Groove Virtual Office, NPS SA Agents, GITI Verona, MIT E-Wall, MS NetMeeting
- Plan and execute a NEO scenario exercise by means of collaborative technology over the NPS Testbed
- Establish operational and application management roles within the team
- Enable sensor and planning data sharing via collaborative tools
- Perform coordination within the team and between the teams
- Enable situational awareness through the use of CT
- Provide operational feedback via CT
- Conduct course of action development using CT

Research Team Composition

- Project participants were organized into four teams to simulate and support the required roles and functions necessary to drive the NEO exercise.
- The teams consisted of a Tactical Operations Center (TOC) that represented the Joint Task Force (JTF) headquarters and Red Cell, a Network Operations Center (NOC) that established, monitored and maintained network and application connectivity at all echelons throughout the exercise, Component Command (CC) representing the Marine Forces (MarFor) component headquarters and Naval Forces (NavFor) component headquarters and finally the Marine Expeditionary Unit (MEU) with assigned Marine Air Ground Task Force (MAGTF) and Amphibious Ready Group (ARG) with assigned SEAL team represented the tactical or maneuver units or elements assigned to the CC.

- This organizational structure allowed for notional Tier 2 thru Tier 4 network and C2 connectivity and is representative of the current operational structure of a JTF with a subordinate NavFor and MarFor component assigned. Although not specifically stated, this structure could just as well have represented a JTF with an assigned Expeditionary Strike Group (ESG) and supporting Carrier Battle Group (CBG).

Shared NEO Planning Workspace in Groove



Expected CT Usage Patterns

Groove: This CT package was designed to be the "backbone" Collaborative Technology for the experiment. The plan called for Groove to provide chat, file sharing, whiteboard, and audio/video communications when coupled with NPS SA Agents. Groove's specific uses were as follows:

-Support collaborative exchange between Tier 1 & 2

-Provide fulltime chat session between watch stations (Routine Traffic)

-Provide on-call VoiceOcer IP session (High Priority Traffic)

-Provide on-call VideoOver IP session

-Act as file manager to support operational planning and document exchange

Verona (GITI): Due to a lack of full integration by the start of the experiment, this tool package was to be only used as a briefing tool to:

-Maintain and pass on the latest information

-Post scenario elements in briefing book

-Each element should be organized into Strategic/Operational/Tactical level sections

-Again, there were no specific support features (chat, whiteboard, file sharing, etc.) that were planned for use.

Expected CT Usage Patterns

NPS SA Agents: The cells had determined that this tool package would only be used for:

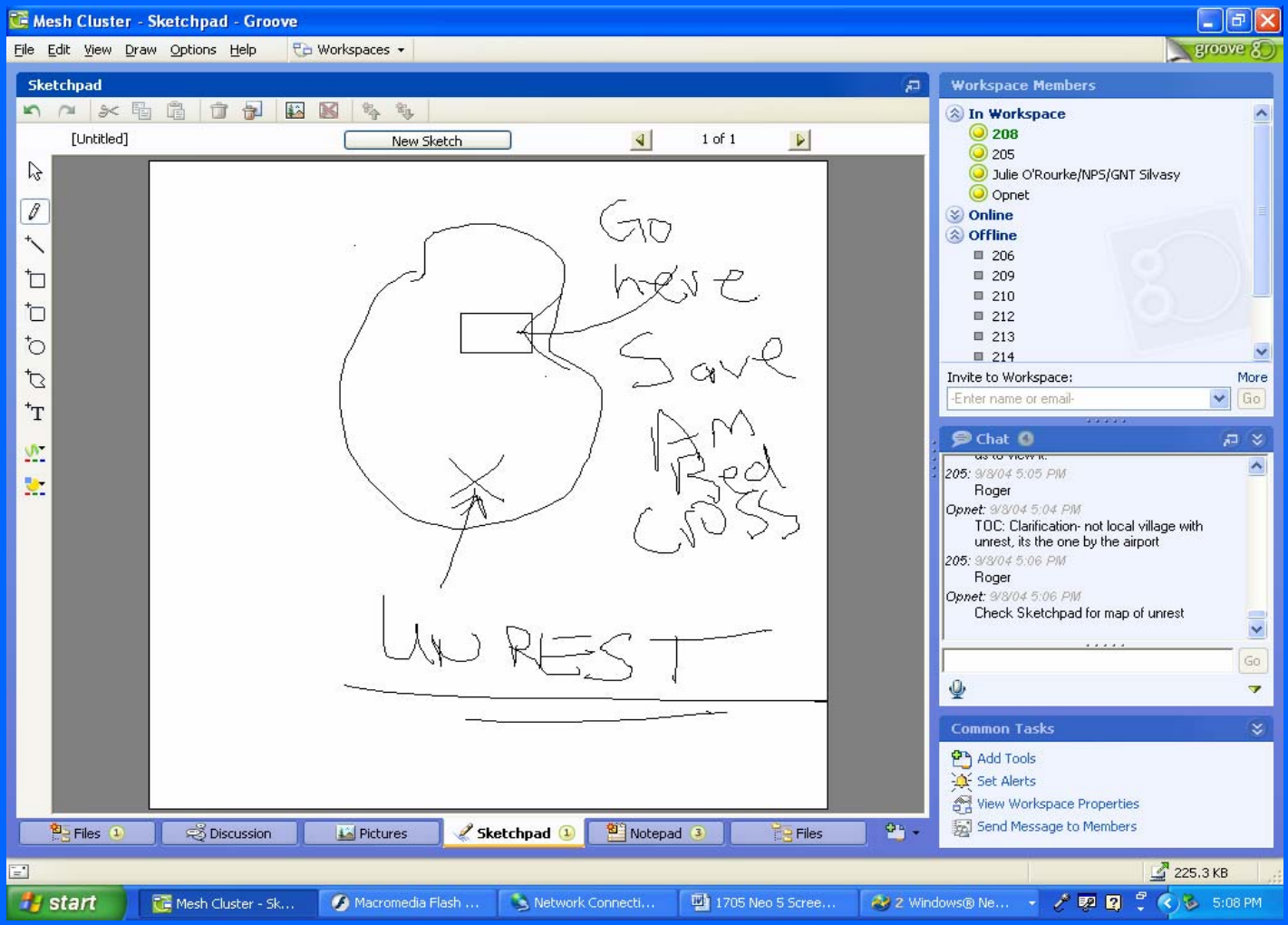
- -Designation of Unit locations
- -Updated Weather
- -Target Video/Movement/Audio using voice and motion activated alarms

E-Wall: This tool package was to be integrated throughout the network, providing "real-time" updates, coordination, and planning functionality. Specifically, this tool package would be used to provide:

- -Planning and Execution Timeline
- -Red Cross Worker Photos and Info
- -Execution Checklist
- -Decision Support Matrix w/Decision Points
- -Requests For Information (RFIs)
- -Network and Communications Status
- -Significant Event Log
- -Live CNN Feed
- -Various Sensor Feeds

NetMeeting v3.1: Planned as a "back-up" to Groove and SA Agents, NetMeeting had the capability to support chat, whiteboard, file sharing, application sharing, and audio/video feeds.

The sketchpad feature of Groove utilized concurrently with chat



Observation and Analysis Tasks

- Describe configuration and operational role of collaboration support features that you made available across the initial CT tool package: file sharing, white board, application sharing, chat, audio/video communications, etc.
- Describe:

  -Communication mode (client-server, peer-to-peer, etc) and networking capabilities that you set up to execute CT applications, and

  -Interfaces and user terminals used by your team to run CT tools

Observation and Analysis Tasks

- Describe your individual role and collaboration support function within the team (or teams)
- Identify coordination/facilitation models used by your team
- Describe user communication and data sharing status awareness features used by your team

Observation and Analysis Tasks

- Present the records of team collaborative tools usage and the event logs your team captured during the experiment
- Explore the timeline and possibly frequency of using different collaborative tools and their data sharing functions during the experiment.
- Identify the nature and frequency of feedback provided to the other teams
- Identify the moments of shared understanding development and critical steps that led to it.
- Describe, if any, CT tool reaction to network congestion and failures
- Provide recommendations for configuring and operating collaborative tools in support of the NEO experiment. Your recommendations on improving the tools would be very helpful.

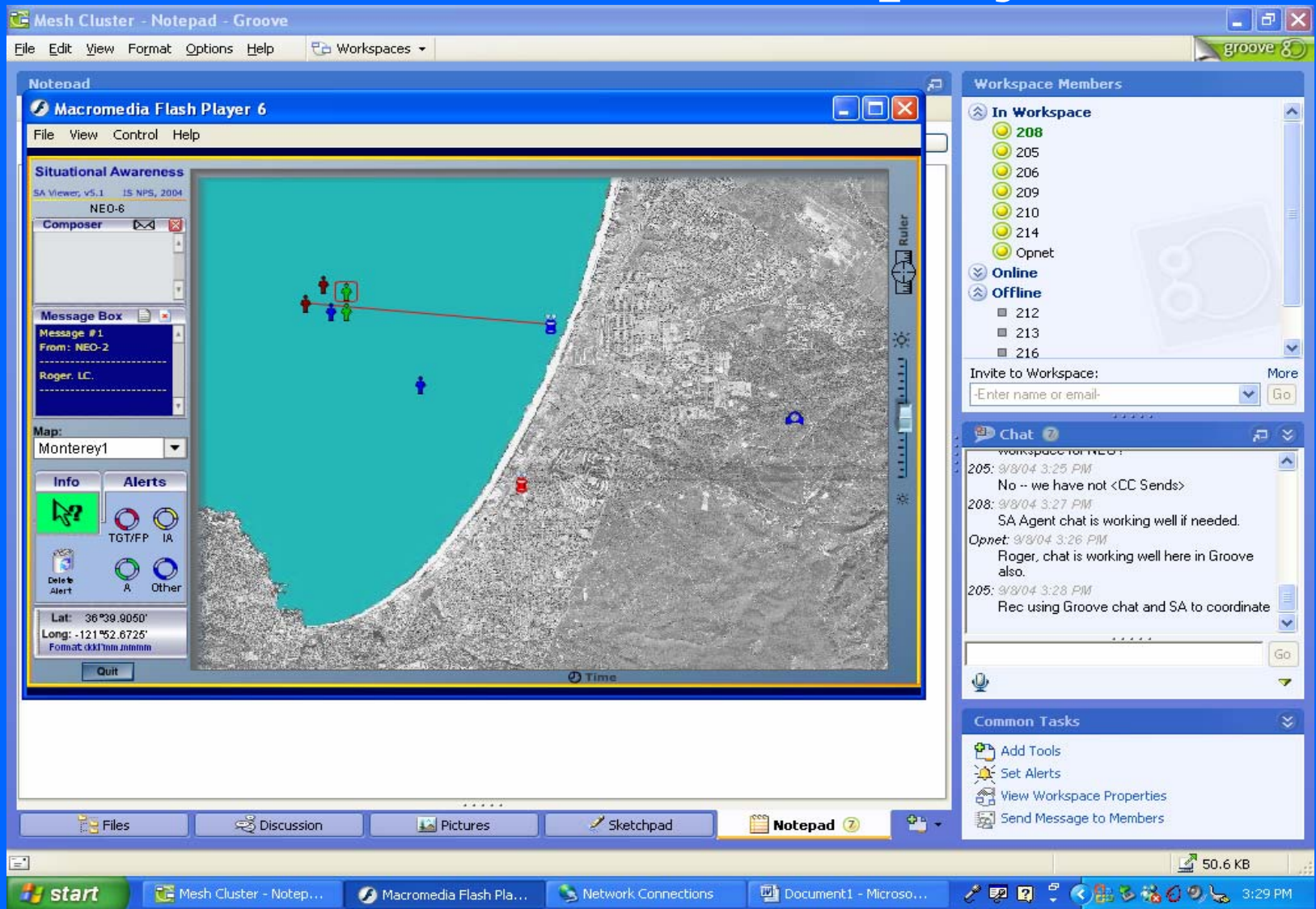
NPS Testbed Tactical Operations Center

Component Command-MEU Evaluation
(Major Jeff Thiry)

NEO Scenario Execution.

- The CC and CC tactical unit teams performed face-to-face coordination during the planning phase of the exercise, simulating the collocation of these elements aboard ship. During this phase the CC team utilized Groove to pass mission essential files, such as the NEO Operation Order and Execution Checklist, to all exercise participants.
- The CC tactical units were unable to receive these files electronically when simultaneous synchronization of Groove effectively shutdown that network segment. The MEU and SEAL elements were forced to “move ashore” into the target area with a hardcopy of the Execution Checklist. Additionally during this phase, it was discovered that MS NetMeeting was unsupportable across the mesh network and the decision was made to utilize the NPS SA Agent as the primary CT with the CC tactical units.
- Based on the limitations discovered during the planning phase, the CC team utilized NPS SA Agents to collaborate and coordinate with the CC tactical units and primarily Groove to collaborate and coordinate with the TOC and NOC teams during the execution phase. The chat display highlights confirmation of this decision.

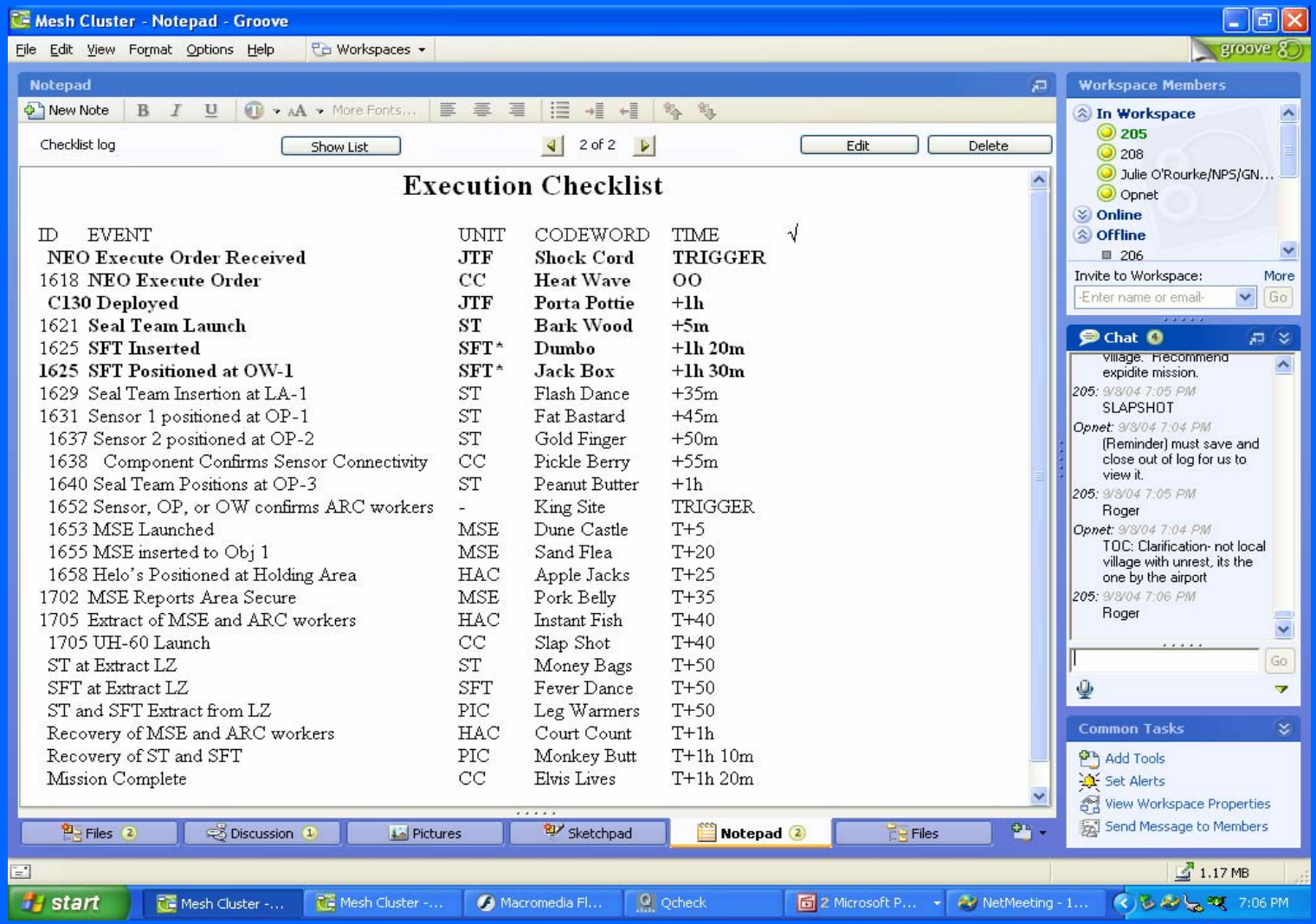
The MEU Chat Display



Developing shared understanding of the extraction plan with Groove

The NEO scenario provided an opportunity to develop an extraction plan that could be executed rapidly. While the CT allowed for the rapid exchange of information and an increase in shared awareness, it was the procedurally developed execution checklist that provided the context and convention for all exercise participants. This checklist was posted to the Groove sketchpad, where it was initially updated by the TOC. The CC team eventually took responsibility for updating the checklist as tasks were completed. Groove chat was used as a redundant means of communicating completion of Execution Checklist tasks.

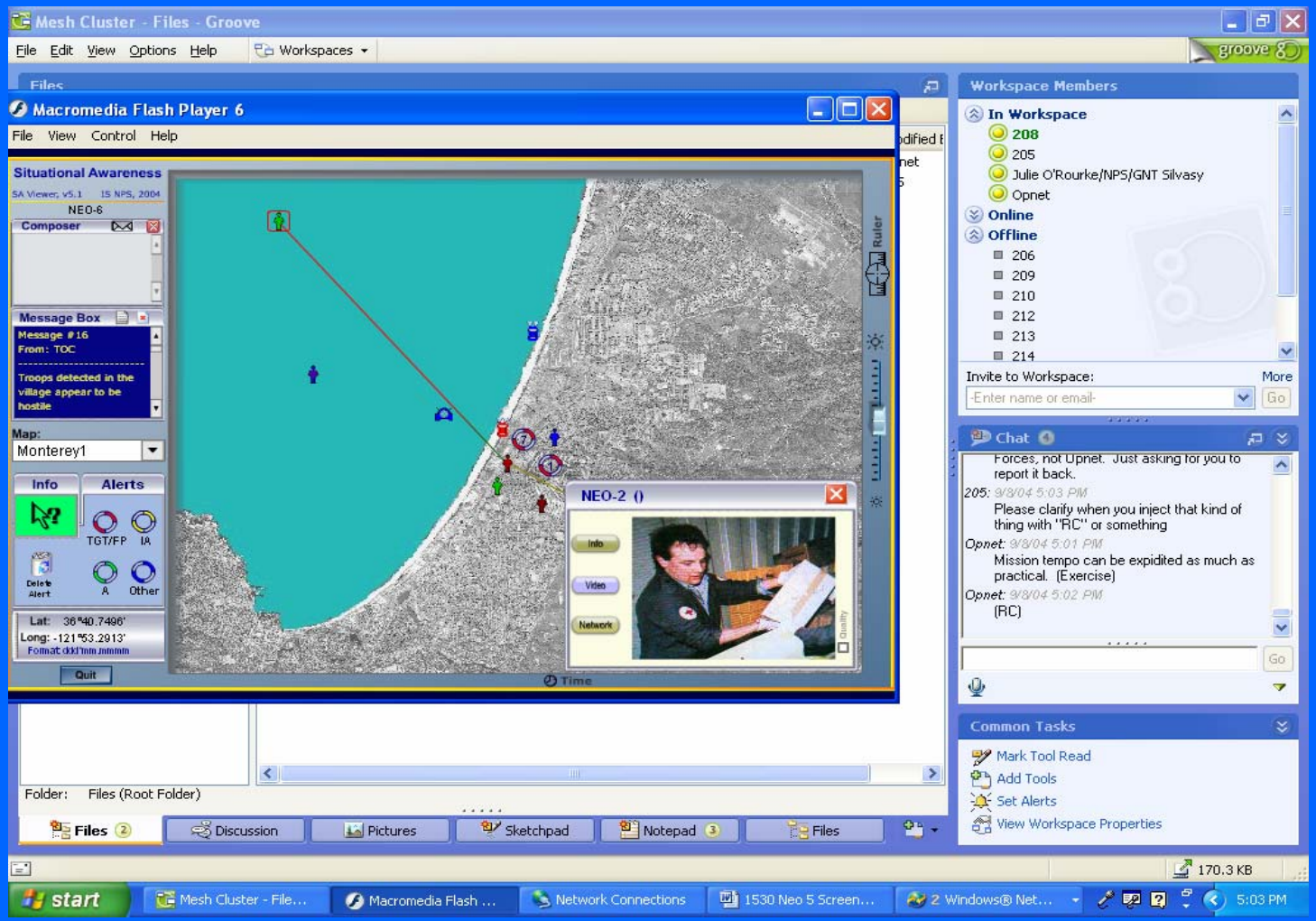
Execution Checklist in Groove



Developing shared situation understanding with SA agents

- The use of the NPS SA Agents proved effective for coordination between the CC team and the MEU and SEAL elements.
- The discreet point-to-point communication method associated with this CT was effectively employed by the Red Cell (co-located with the TOC) to pass surveillance, targeting and acquisition injects to the MEU and SEAL team elements.

An example of the discrete communications path and shared sensor data display provided by the NPS SA Agents combined with Groove.



The CC Team Table

The table lists the CT utilized or intended to be utilized by the CC team and provides a brief evaluation of the effectiveness to coordinate and collaborate with the TOC (higher headquarters) and CC tactical units (subordinate MEU & SEAL elements).

	Groove	NPS SA Agents	NetMeeting	E-Wall
Chat	All teams had Groove installed on local workstation. Primary means to exchange information. Identifies message sender and places DTG stamp on each transmission. Chat input and output display windows are expandable. Microphone feature allows for transfer of audio chat messages. Unable to generate private chat.	Became the CC primary means to coordinate and communicate with CC tactical units (MEU & SEAL elements). Effective for point-to-point communications, the only means for broadcast to the all participants was by posting an alert notice.	Installed and enable on CC and CC tactical unit workstations. Unable to establish application connectivity between	N/A
Sketchpad/ Whiteboard	Allowed TOC and CC to collaborate on various files (.ppt and .doc). Only one participant can access the file at a time.	N/A	Unable to establish.	N/A
File Share/ Transfer	All teams were not synchronized prior to StartEx. This feature was abandoned by the CC tactical units due to network bandwidth overload.	N/A	Unable to establish.	Although not utilized for this purpose, access to portion of the E-Wall by external organizations could allow critical files (Sig Events, sensor feeds) to be posted automatically.
Application Sharing	N/A	N/A	Unable to establish.	N/A
VOIP	Utilized dedicated IP telephony as alternate means of communication between NOC, TOC and CC. Very effective.	Could provide the means of conducting VOIP session.	Unable to establish.	N/A
VTC	Unable to establish due to lack of AV equipment.	Could provide the means of conducting VTC.	Unable to establish.	Could provide the means to display the video portion of a VTC. A briefer could have all relevant and supporting information readily available on the E-Wall while conducting a VTC.

EWall Capability Analysis

- The CC team did not utilize or have access to the MIT E-Wall hosted by the TOC. The combination of E-Wall and agents lend themselves to the dynamic gathering and display of time and mission critical information. The capability to display real-time audio and video feeds from remote sensors was not available during the exercise. Consideration should be given to the development of agents that support the various windows associated with the E-Wall. Utilizing agents, such as the NPS SA Agents that provide position reporting, could be used to update situational awareness displays on the E-Wall.
- The first iteration of this development could be the use of single, instruction-based agents that learn through supervised feedback to populate the situational awareness displays. The windows in the E-Wall would provide decision makers with dynamically updated information based on the identified information requirements. These requirements would be different based on the decision maker and the mission type.
- The second iteration would begin to couple agents into a Multi-Agent System that could learn by understanding organizational roles or explanation-based reasoning. Model selection would depend on the intended Multi-Agent System tasks. This combination might then be able to provide synthesized, detailed analysis directly to the decision maker and his staff or for display on the E-Wall.

Conclusion: major CT limitations in supporting shared situational understanding development

- The CT package used by the CC team consisted of tools that required a moderate to high level of expertise to connect, operate and maintain. Groove was the most complex tool and while team members had utilized the application for about 2 months prior to the exercise no formal training was ever conducted. Additionally, the robust features within Groove provide a distraction and time drain on the operator tying to navigate through the myriad of tabs within a single Groove workspace.
- The NPS SA Agents was relied upon quite extensively and proved fairly simple to operate but required a technical support to add remote sensors and provided limited point-to-multipoint communication (Alert Notices).
- A CT with a single user interface display, intuitive icons or menus that is easy to activate and customize, and automatically seeks and connects to other like services/networks/agents would be beneficial at all levels, not just the tactical level.

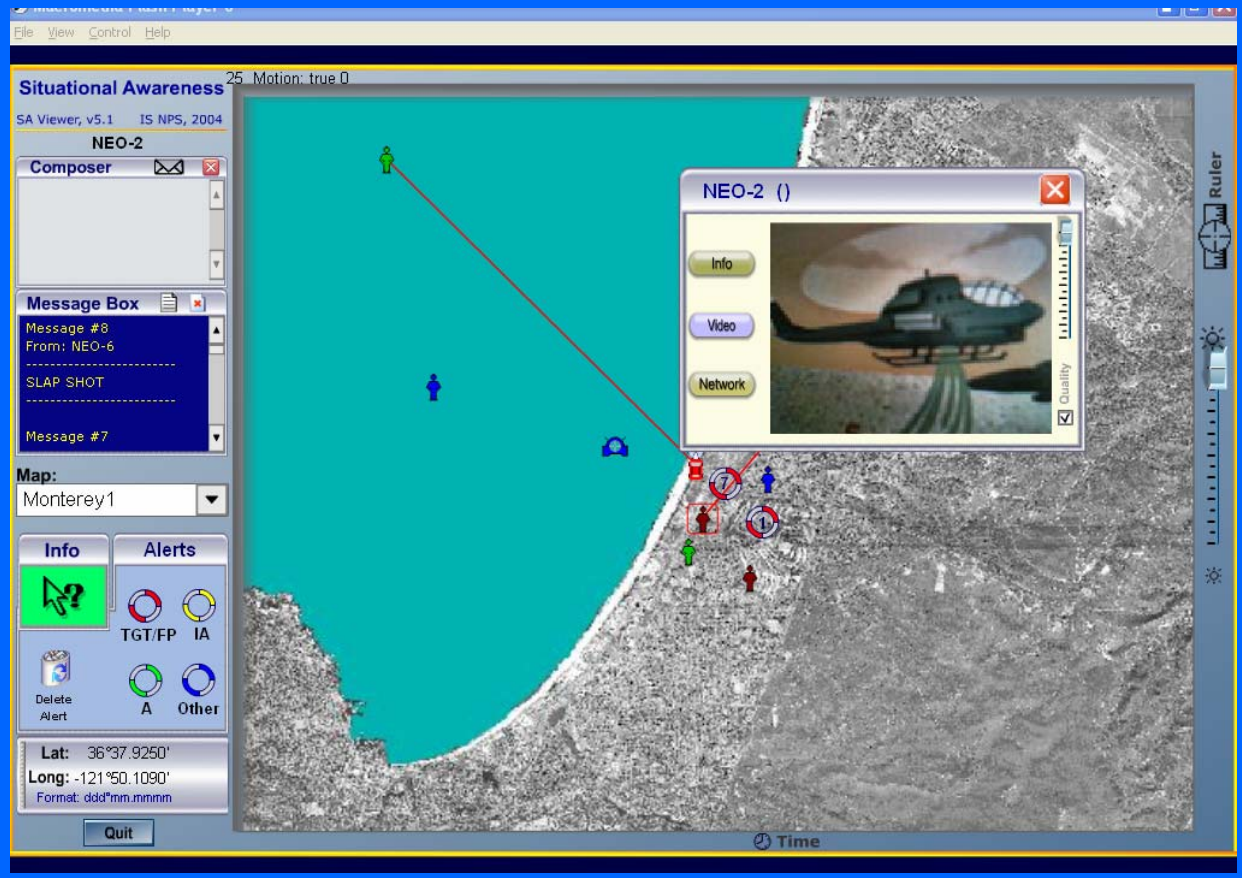
SEALs Team Evaluation
(LT Greg Milicic)

SEALs Work with CT

- After the set up, the SEAL Team ventured further out on the roof of Spanagel to simulate being delivered to the field. This flexed the mesh network and forced members to rely on the network and its tools for coordination and collaboration.
- Video simulates the sighting of Red Cross workers to amplify the information presented in the alerts ("KING SITE" was the brevity code word corresponding to "Red Cross workers located") overlaid on the SA map. Another team had also placed an alert and the messaging feature was used to transmit another brevity code ("Applejack") from the script to move the timeline along.

Illustration of the receipt of orders from higher command via SA Agent messaging.

Illustration of messaging used to transmit a message to higher authority that the SEAL Team has extracted from the battlefield and with a corresponding video of a helicopter in flight.



Role and Coordination Model

- SEAL Team. As a SEAL Team, we played the role of the most distant node on the mesh network. I provided video feed and motion events to the rest of the team through the SA Agent and in the end to the TOC in EWall. I also served as a pseudo NOC player by helping to set up and configure the mesh network and the bridge on top of Spanagel Hall
- *COORDINATION MODEL:*
- The dynamic was that of a team with a single decision maker. While this closely reflects the reality of military operation, it was unnecessary in the development and execution of a scenario for educational purposes. Feedback and educational goals seemed to be dismissed because of the artificiality they would impart on the scenario in favor of strict adherence to the planning process in place in theater level staffs.
- The scenario was to be run in a blackboard coordination fashion where a script was followed which generated timed events. These events would then create instances for implementing coordinated problem solving. In reality, the decision to shut down Groove led to a strictly point-to-point communication environment and without a script, the coordination on my end was that of waiting to receive and instruction and responding with an appropriate response

TIMELINE/FREQUENCY OF CT TOOLS USE

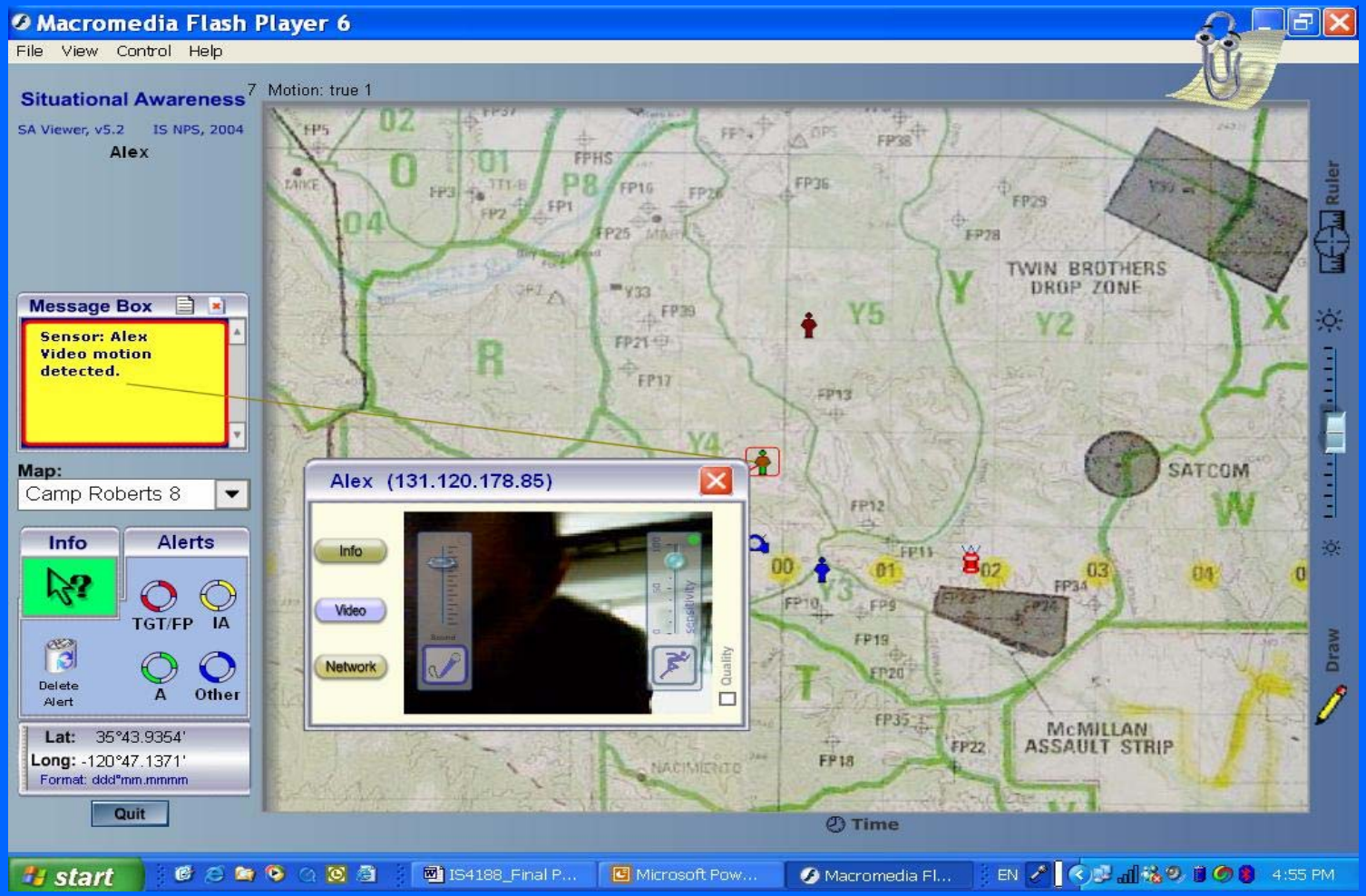
The SEAL Team used the SA Agent tool almost exclusively. At the onset, the plan was to use Groove for planning and coordination and the SA Agent for execution and to pass video/motion detect events. However, a large data file describing the NEO execution bogged down the Groove network over the mesh and the decision was made to shut down Groove on all of the wireless users. So from that point on, the timeline and frequency of use issue for the SEAL Team was simply consistent use of the SA Agent.

SHARED UNDERSTANDING DEVELOPMENT

- There was no real critical moment of shared understanding during the experiment with the SEAL Team. We sensed that there was more of a shared understanding between the players in the GIGA Lab and those in the covered part of the roof of Spanagel (i.e. the TOC and the ARG/MEU which is also analogous to the wired players). However, the distant nodes on the mesh network basically awaited an instruction to transmit a brevity code and then did so.
- The function of the SEAL Team could have been completely automated for the purpose of this experiment. Instead of the distant ends providing the rest of the hierarchy with simulated real time feeds and events that would shape the understanding and coordination of the planners, they simply provided an input when directed to provide that input. Intuitively, this is backwards.
- The distant ends should have the most fully real-time and accurate situational awareness of which they provide a glimpse of to the rest of the food chain. These players in turn take what inputs they get to try to piece together an awareness that as closely as possible replicates the distant users (for example using the EWall) in order to make decisions and further coordinate the efforts of and in support of the distant end. In the case of this experiment, it seemed the tail wagged the dog

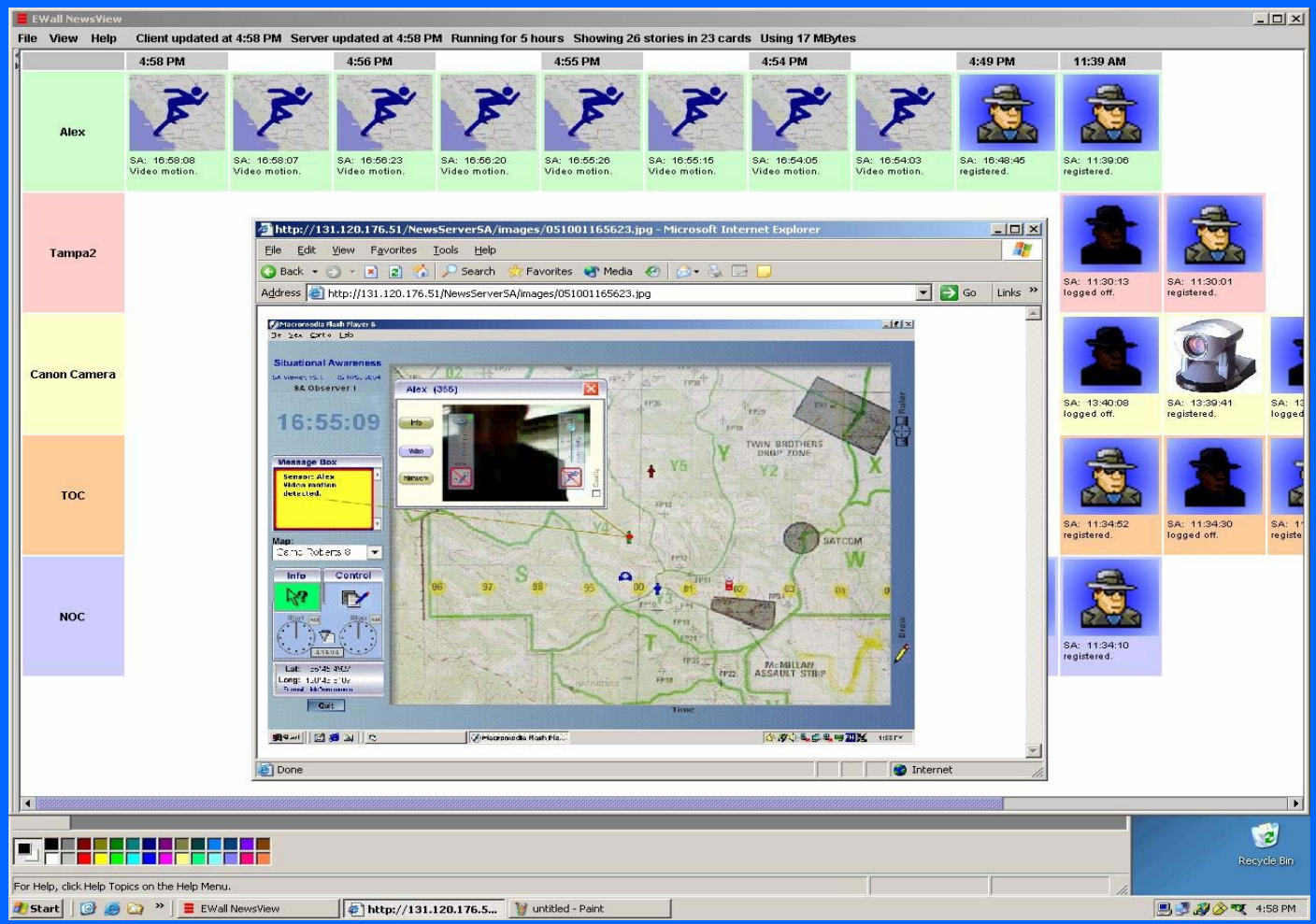
EWall Integration : Creating the Situational Awareness Memory

Peer-to-Peer data sharing via the SA Agents representing sensors and Decision Makers

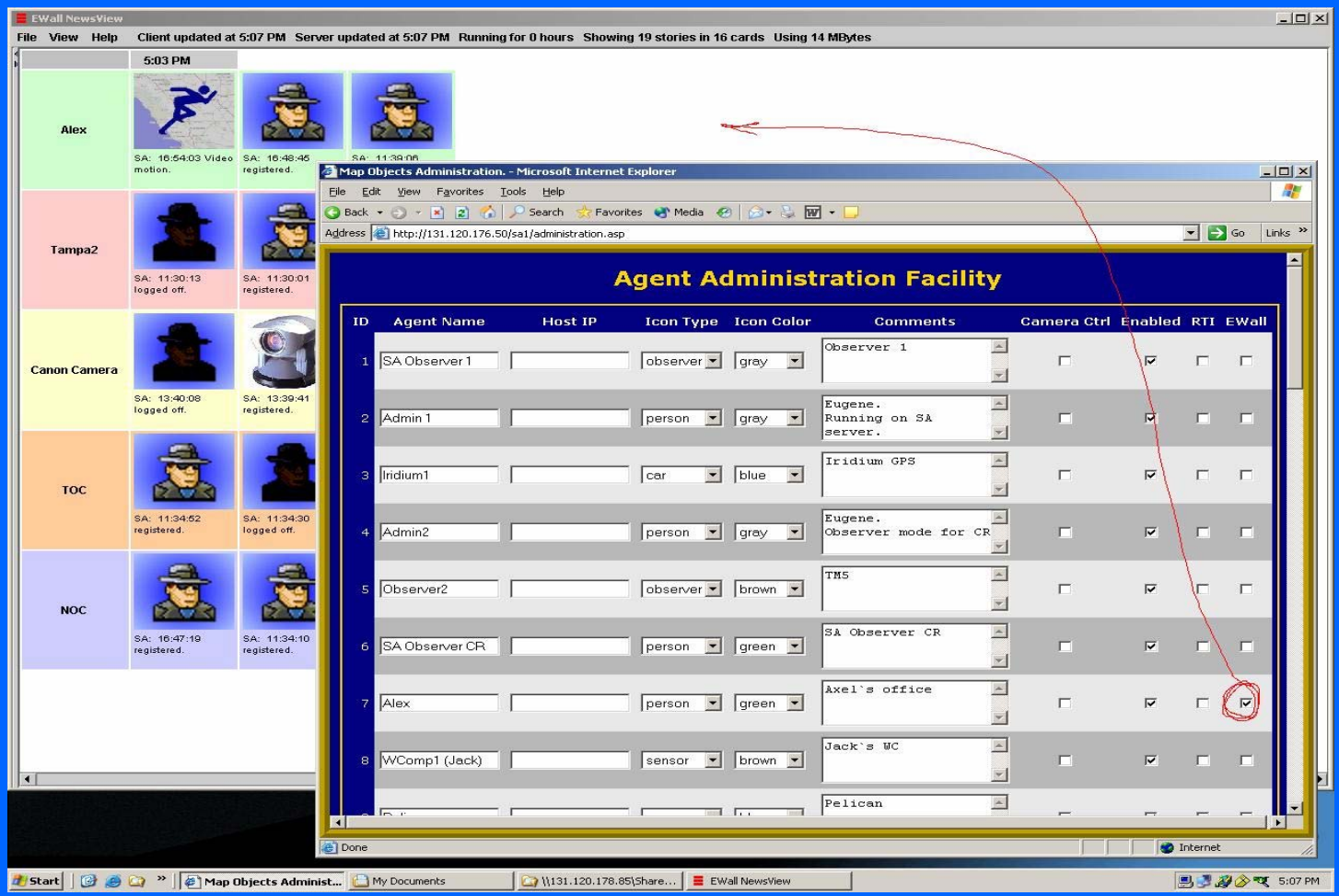


SA Agents output is captured by the NPS interface to the EWall News Server

Agent-EWall integration creates network-centric memory mechanism for developing shared understanding of SA events



Data Base Integration of Sensor-DM Agents and EWall Servers



Next Steps

- Sensor-DM input integration with EWall Exchange and Workspace Servers
- Thesis projects completion: Maj Chris Bey, LCDR Joe Herzig, and LT Greg Milicic
- Test trials in SOCOM experiments
- Publication in Information Systems Research Journal, ACM Communications, and HICSS Proceedings

NPS Tactical Network Topology (TNT) Field Experimentation Program

Information Sharing and Collaborative Action/ Intelligent Network Design

MOPs: Latency

Network reliability

Video quality

Groove P2P functionality

Performance of file sharing, image-shared editing, text-shared editing, synchronization actions, voice and text message frequencies

OFT Stiletto and / or Virtual Mission Operating System

Tacticomp with Goggle Cam

TERN UAV Video

CIRPAS Marina

Groove Collaborative Action

802.11b

Camera

Ft. Bragg

Tampa

Internet

TOC NPS

TOC Camp Roberts

Army SATCOMSTA

Questions?

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